

Smart Grid Metrics Monitoring our Progress

Smart Grid Implementation Workshop

Joe Miller - Modern Grid Team

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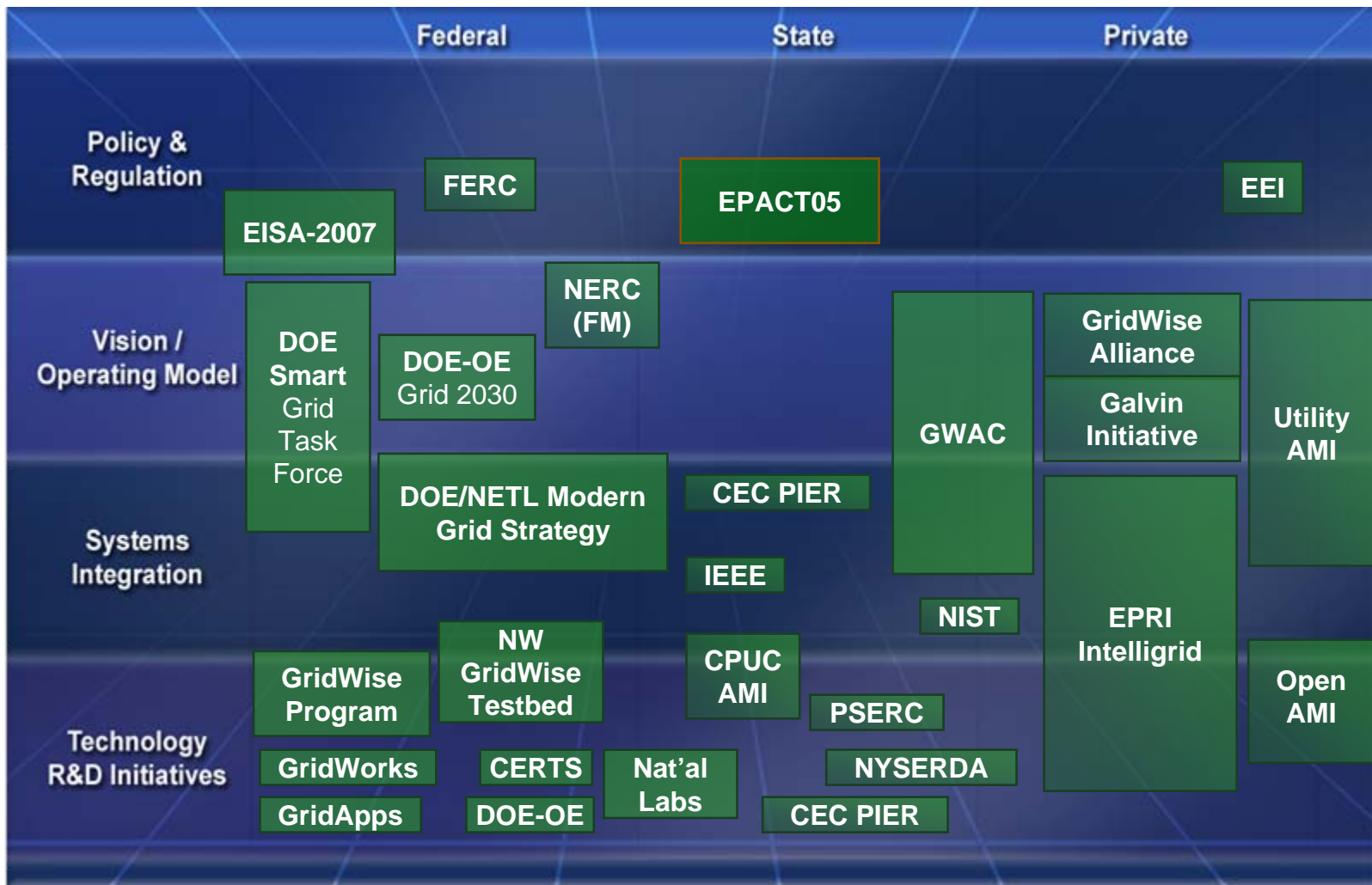


Funded by the U.S. Department of Energy,
Office of Electricity Delivery and Energy Reliability



Conducted by the National Energy
Technology Laboratory

Many are working on the Smart Grid



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The Smart Grid will:

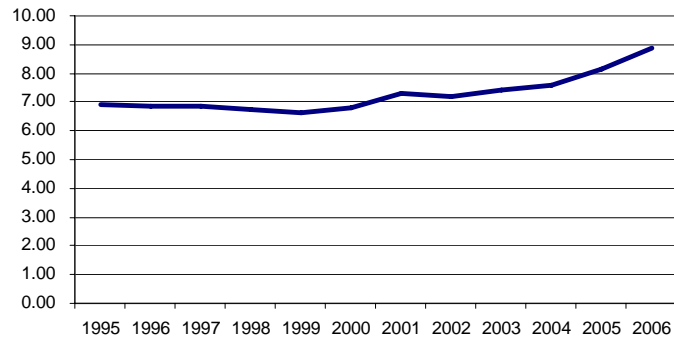
- Enable active participation by consumers
- Accommodate all generation and storage options
- Enable new products, services and markets
- Provide power quality for the digital economy
- Optimize asset utilization and operate efficiently
- Anticipate & respond to system disturbances (self-heal)
- Operate resiliently against attack and natural disaster



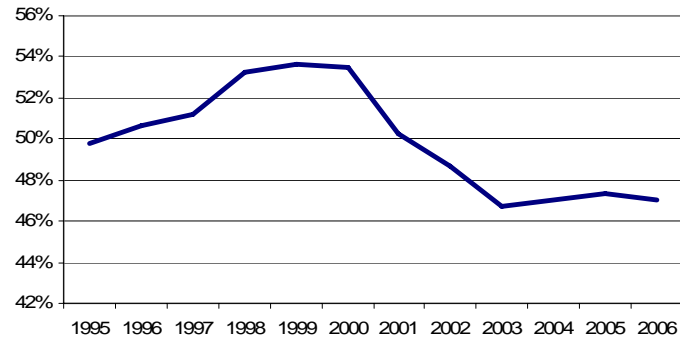
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Metrics are everywhere

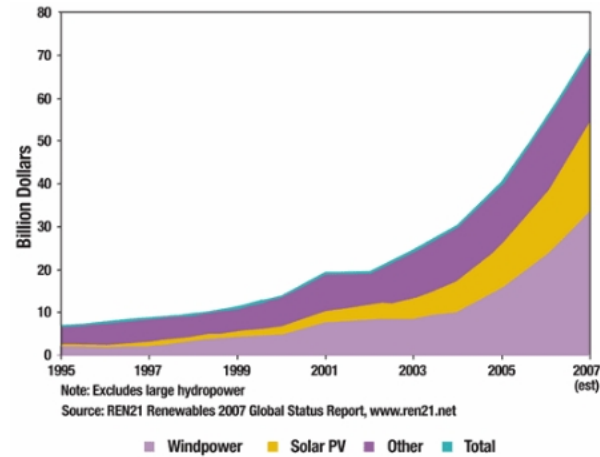
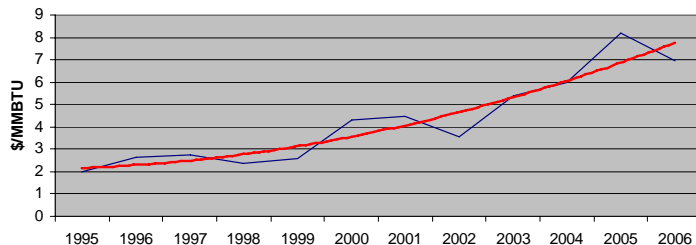
Average Retail Price (cents/kwh)



Generation Asset Utilization



Wholesale Natural Gas Supply to Electric Generators



What is a Metric?

- **A standard of measurement (per Webster)**
- **A count or measurement**
- **Measurable and objective**
- **Can be trended**
- **Linked to an objective – needs context**
- **Metric categories**
 - Value
 - Build



Why do we need metrics?

■ **Keep us on track**

- Identify successes and opportunities for improvement
- Initiate Corrective Action to address problems
- Reinforce good progress
- Serve as an effective communication tool
- Create alignment and motivation among stakeholders

■ **Enable us to project future progress**

- Establishes baseline for target setting
- Provides insights for interdependent efforts
- Keeps the “end in mind”



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An example:

Nuclear Power's Success Story

Some Metrics That Supported It



Objective – Improve Economics

Metrics

- Refueling Outage Duration
- Production Cost
- Capacity Factor

Objective – Improve Nuclear Safety

Metrics

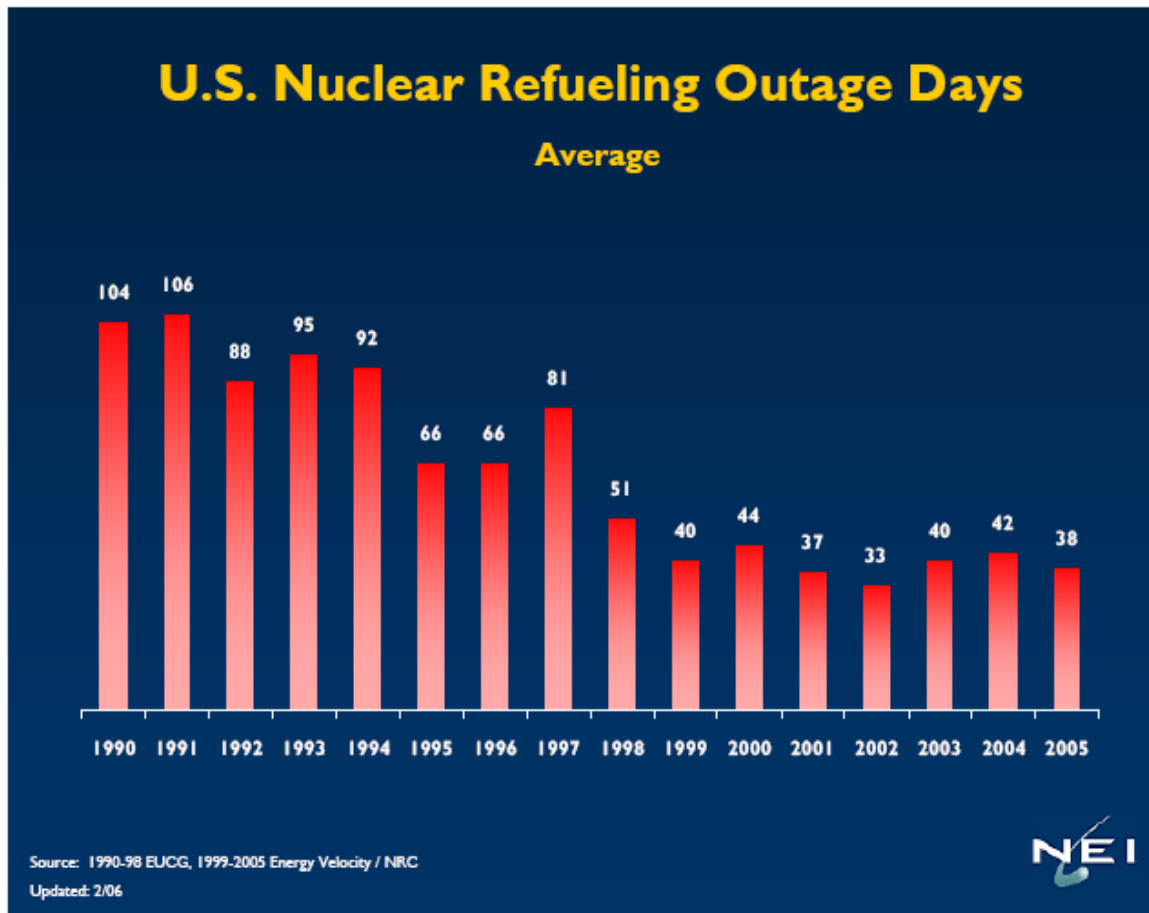
- Industrial Safety
- Safety System Performance
- Radiation Exposure

The Nuclear Power Industry has a spokesman!



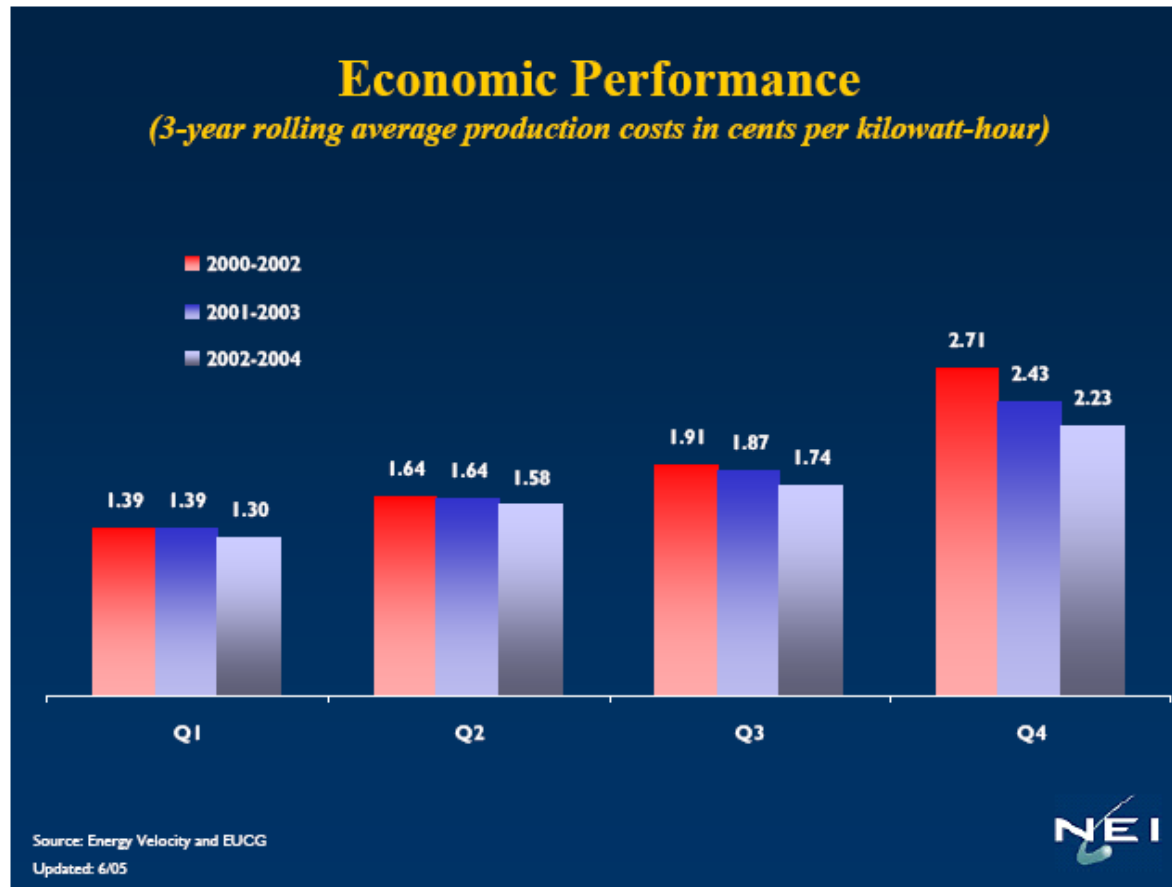
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Example - Nuclear Power Metric



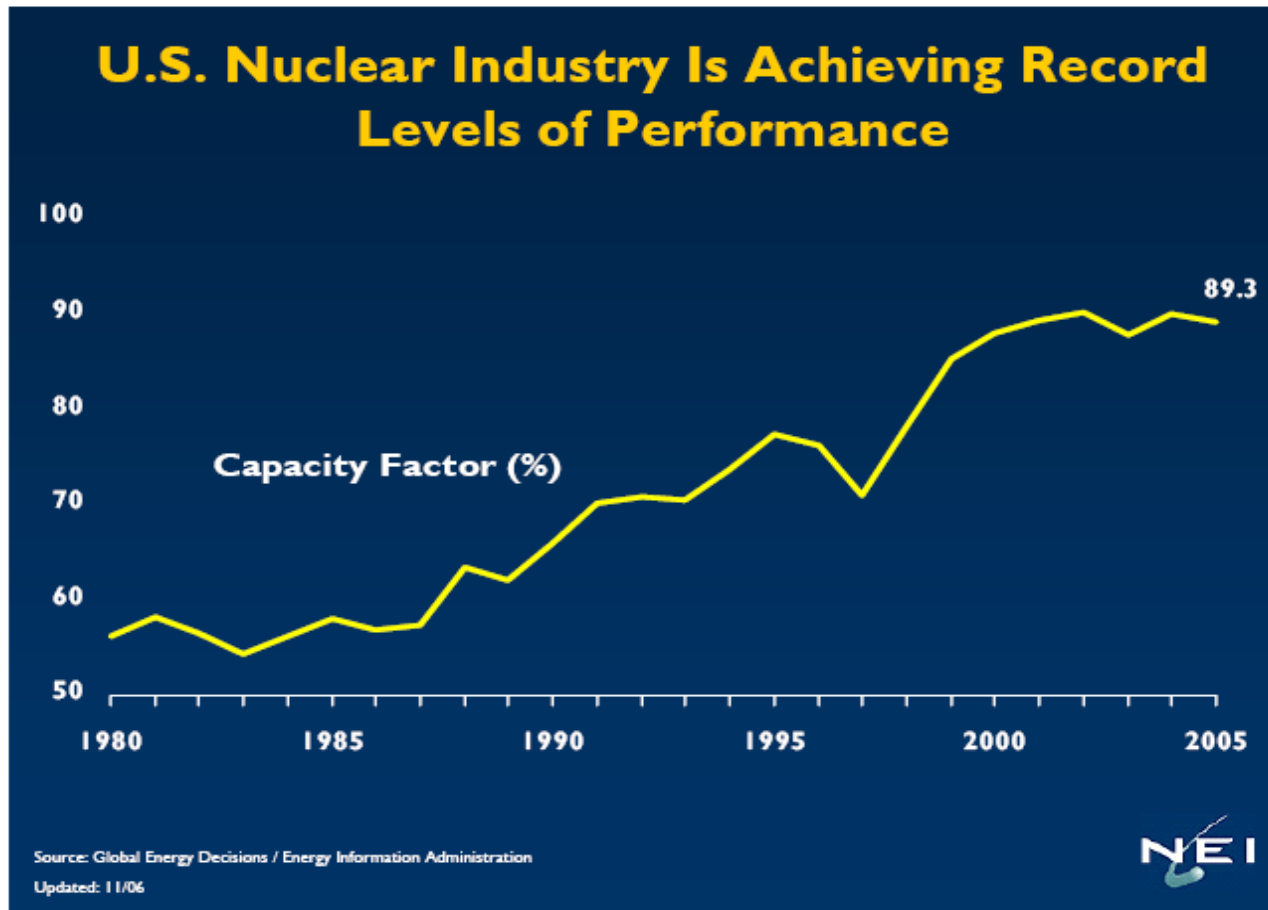
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Example - Nuclear Power Metric



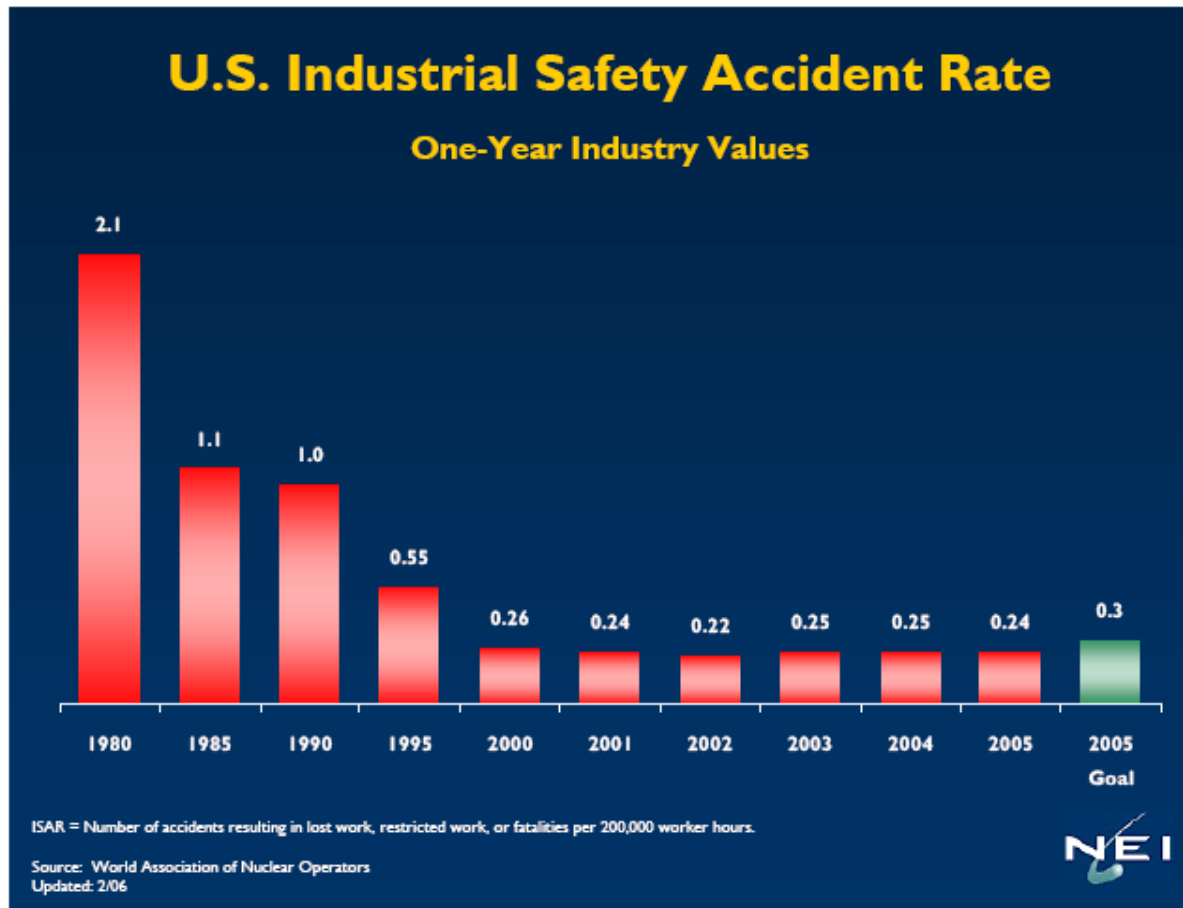
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Example - Nuclear Power Metric



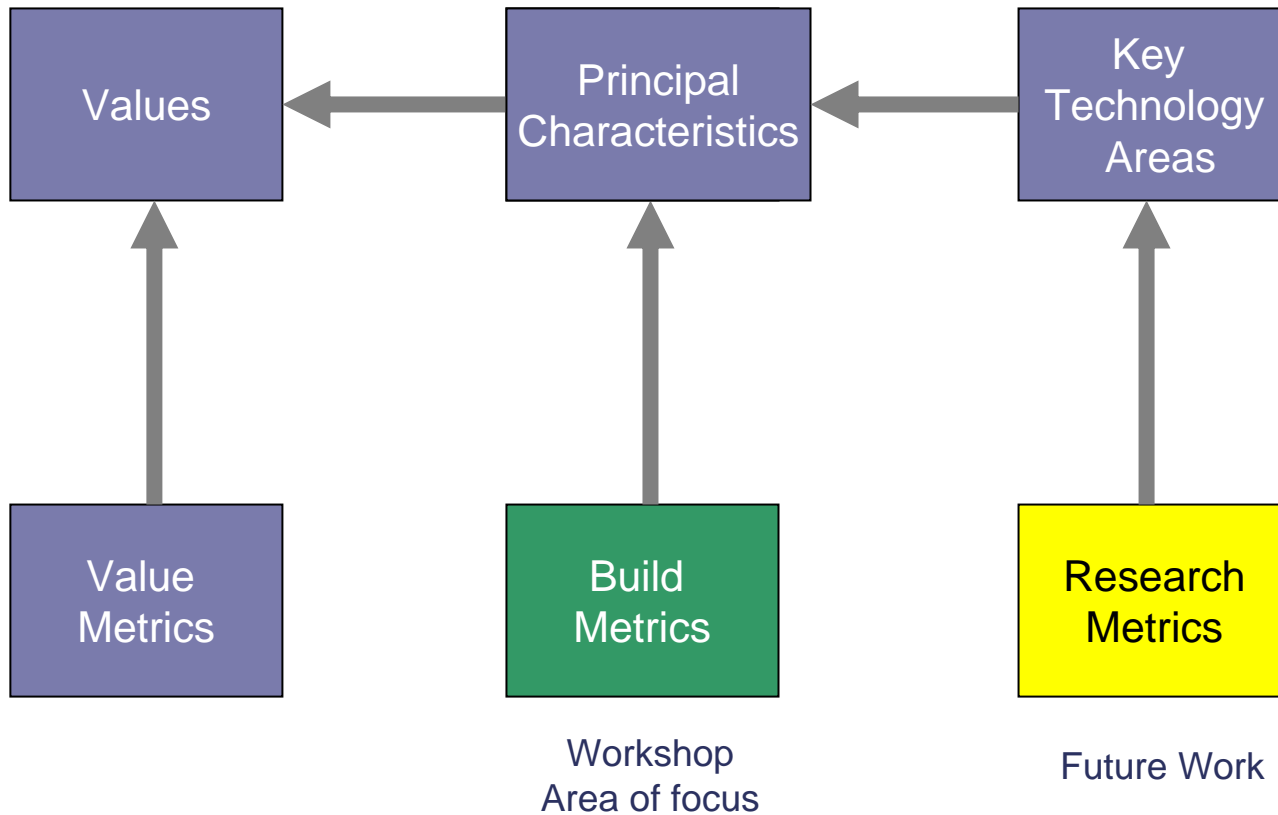
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Example - Nuclear Power Performance Indicator



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Smart Grid Metric Map



Reliability

- Outage duration and frequency
- Momentary outages
- Power Quality measures

Security

- Ratio of distributed generation to total generation
- Number of consumers participating in energy markets

Economics

- Peak and average energy prices by region
- Transmission congestion costs
- Cost of interruptions and power quality disturbances
- Total cost of delivered energy



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Efficient

- System electrical losses
- Peak-to-average load ratio
- Duration congested transmission lines loaded >90%

Environmentally Friendly

- Ratio of renewable generation to total generation
- Emissions per kilowatt-hour delivered

Safety

- Injuries and deaths to workers and public



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Linking Metrics to the Characteristics:

- Enable active participation by consumers
- Accommodate all generation and storage options
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